Bay County Mosquito Control

Annual Report

2009

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2009 Mid-Michigan Mosquito Control

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Organization

Bay County Mosquito Control began operations within the organizational structure of the Bay County Health Department and under the auspices of the Bay County Executive in January of 1985. The program began in 1977 as part of the bi-county district, Saginaw-Bay Mosquito Control Commission.

Mosquito "control" doesn't mean elimination, but involves IPM (Integrated Pest Management) methods designed to reduce the number of mosquitoes so they no longer unfavorably affect the health and quality of life of Bay County residents.

As one of the divisions of the Environmental Affairs and Community Development Department, we acknowledge the importance of serving the public by providing services without producing adverse impacts on the environment. The program consists of field operations, biological surveillance, disease surveillance, and education.

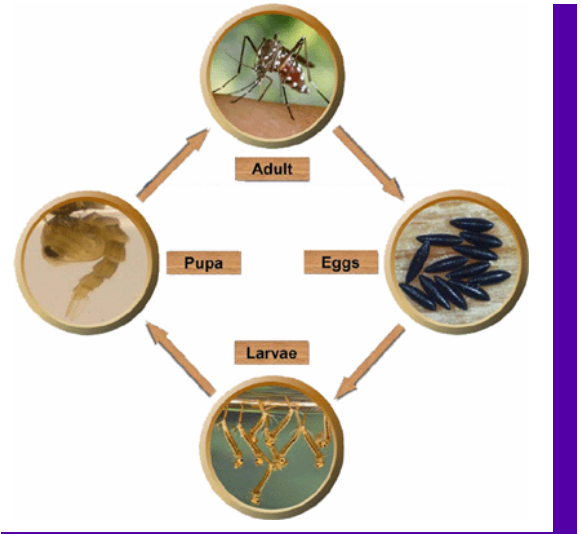
Bay County is one of four Michigan counties with formal, comprehensive mosquito control programs. A Technical Advisory Committee (TAC), composed of local and state professionals, reviews program operations each March.

Funding is received from a special millage for the control and abatement of mosquitoes and the diseases borne by mosquitoes. The current 0.45 mill tax levy was renewed on August 5, 2008 for an additional eight years in Bay County with an overwhelming approval rating of 84%. This millage rate has been in place since 1988.

Mosquito Biology and Life Cycle

Mosquitoes are aquatic insects that undergo a complete metamorphosis involving four distinct stages—egg, larva, pupa, adult—throughout their life cycles. Female mosquitoes can develop several hundred eggs with each blood meal and lay them in or around water. The eggs are laid on moist ground, on the water's surface, or attached to one another to form a raft that floats on the water's surface. Eggs laid on water hatch quickly and release larvae that wriggle through the water. The larvae are filter feeders that eat voraciously and outgrow their skin, which causes several molts before pupation. About one week after the eggs hatch, larvae change to pupae, the non-feeding stage where the final transformation to adulthood takes place. Eclosion is the emergence of the adult mosquito from the pupal case. These newly-emerged adults use the cast skin for support until their wings and body dry, at which time they fly away.

After mating, females seek out an animal upon which to feed and this blood provides protein to develop eggs. Males don't bite, but they do have sucking mouthparts to obtain plant nectar as a source of energy; females do this as well. Next, females search for an aquatic habitat or moist ground to deposit eggs. Although there are exceptions to the rule, most adult mosquitoes live for a period of four to eight weeks.



Spring Larval Surveillance

As a result of spring flooding due to rainfall or snowmelt, the potential exists each year for significant spring mosquito larval development in the woodland areas of Bay County. Spring aerial treatment utilizing one helicopter and two fixed wing aircraft was conducted when larvae reached the second instar growth stage. Monitoring larval development was critical in order to have a timely application of *Bti* (*Bacillus thuringiensis israelensis*), a bacterium eaten by larvae that caused mortality within 48 hours. The *Bti* can be used as a safe food source by other aquatic organisms that occupy the same woodland pool habitats.

Surveillance was an essential part of the successful mosquito control program. Mosquito larval surveillance began in late March with first instars observed in woodland pools. Pools had formed in many woodlots and monitoring indicated medium density (5-10 larvae per dip) in most sites. Pre-treatment larval counts were taken between one and three days before treatment in 42 woodlots.

Aerial calibration took place on April 9th with treatment beginning later that day and lasting eight days until April 17th. Aircraft were calibrated to deliver approximately 5 pounds of *Bti* per acre. Quality control of the spring aerial campaign was accomplished with the help of a full-time supervisor, biologist, and three certified technicians. Staff walked through 134 treated woodlots over the course of 8 days in order to determine both the average number of *Bti* granules per square foot, which helped confirm the dosage rate, and locate possible skips or misses occurring with the aerial application. The number of granules per square foot averaged 4.07 for all woodlots checked, which corresponded to 5 pounds/acre.

Post counts indicated an overall average 94.8% larval mortality (Table 1). Most woodlots had excellent *Bti* coverage and, as usual, where there was *Bti*, there were either no mosquito larvae found or only dead larvae floating throughout the water column. Frogs, fairy shrimp, water fleas, copepods, and caddisflies that were observed in the woodland water habitats before treatment were found in large numbers after treatment, as well.

Table 1

Spring Treatment 2009 - Bti Evaluation				
		Larval Count		
Location	**Applicator**	**Pre**	**Post**	**Mortality**
Bangor 4 - Bangor Oil Well	Helicopter	3.41	0.12	96.5%
Bangor 31 - St. Maria Goretti Church	Helicopter	1.3	0.32	75.4%
Bangor 32 - State Park	Helicopter	1.87	0	100%
Bangor 33 - Bangor and Zimmer	Helicopter	2.28	0	100%
Beaver 4 - 1576 Cottage Grove	Fixed Wing	3.4	0	100%
Beaver 5 - Carter and Cottage Grove	Fixed Wing	1.58	0.34	78.5%
Beaver 9 - 1585 Cottage Grove	Fixed Wing	2.38	0	100%
Frankenlust 2 - Four Mile and Delta	Helicopter	4.88	1.02	79.1%
Frankenlust 3 - Delta at Mackinaw Road	Helicopter	1.68	0.14	91.7%
Frankenlust 3 - Delta by Automotive Bldg.	Helicopter	5.44	0	100%
Frankenlust 7 - 259 Amelith Road	Helicopter	3.98	0.62	84.4%
Fraser 6 - Townline 16 by 7 Mile Rd.	Fixed Wing	0.96	0.12	87.5%
Fraser 11 - Camp Fishtales	Fixed Wing	0.72	0	100%
Fraser 15 - Fraser Twp. Firebarn	Fixed Wing	3.825	0.375	90.2%
Fraser 22 - Fraser Twp. Hall	Fixed Wing	1.16	0	100%
Garfield 9 - 11 Mile N. of Erickson	Fixed Wing	1.22	0	100%
Garfield 10 - Garfield Twp. Park	Fixed Wing	3.975	0	100%
Garfield 15 - Methodist Church	Fixed Wing	0.76	0	100%
Garfield 26 - Crump Fox Club	Fixed Wing	2.875	0.26	91%
Kawkawlin 2 - 2080 LeBourdais Rd.	Fixed Wing	2.16	0.02	99.1%
Kawkawlin 30 - Bay City Bowmen's	Fixed Wing	1.18	0	100%
Kawkawlin 30 - White Birch Village	Fixed Wing	2.52	0	100%
Monitor 9 - 1306 Wheeler	Helicopter	2.24	0.6	73.2%
Monitor 20 - Fraser and N. Union	Helicopter	1.2	0.15	87.5%
Monitor 23 - Rocking Horse Ranch	Helicopter	2.24	0	100%
Monitor 28 - Mackinaw Road Tech Park	Helicopter	4.24	0.02	99.5%
Monitor 34 - Fremont Cemetery	Helicopter	0.96	0	100%
Mt. Forest 21 - Mt. Forest School	Fixed Wing	4.04	0.74	81.7%
Mt. Forest 21 - Mt. Forest Firebarn	Fixed Wing	1.36	0	100%
Mt. Forest 30 - Pinconning and Cnty Line	Fixed Wing	1.08	0	100%
Pinconning 19 - Pinconning County Park	Fixed Wing	1.4	0	100%
Pinconning 23 - K C Hall Water Street	Fixed Wing	0.875	0	100%
Portsmouth 35 - R & R Ready Mix	Helicopter	2.1	0	100%
Williams 16 - Carter and N. Union	Fixed Wing	1.08	0.04	96.3%
Williams 19 - Victoria Woods Trailer Park	Fixed Wing	3.06	0.2	93.5%
Williams 20 - Forest School/Daycare	Fixed Wing	4.12	0	100%
Williams 21 - Forest Edge	Fixed Wing	5.8	0.08	98.6%
Williams 30 - Rockwell and Salzburg	Fixed Wing	1.88	0	100%
Delta - Water Tower	**Control**	5.44	4.84	11%
Mt. Forest 9 - Sand and Eleven Mile	**Control**	1.34	1.16	13.4%
Mt. Forest 17 - Mt. Forest and Carter	**Control**	0.84	0.76	9.5%
Mt. Forest 30 - Pinconning and County Line	**Control**	1.08	1.01	6.5%
AVERAGE MORTALITY (Treated)				**94.8%**

Summer Larval Surveillance

Surveillance is the key component of an IPM (Integrated Pest Management) program and there are two main types — larval and adult —both of which are done to monitor mosquitoes county-wide to determine distribution, density, and species. Surveillance is a combined effort conducted by larviciding crews, field supervisors, and biology personnel.

Staff conducted routine surveillance of probable mosquito breeding sites using a standard pint-size dipper. These stagnant water sites included ditches, catch basins, flooded fields, woodlots, and tires. Roadside ditch larval site inspections, termed sequential sampling, occurred weekly throughout the county and larval samples were collected and identified to determine the need for control. One hundred forty-four larval samples representing twelve species were identified; the majority were *Culex restuans* followed by *Culex pipiens* and *Aedes vexans*. Seven larval samples were *Aedes japonicas,* the newest mosquito species to Bay County, which was found breeding in tires, containers, and ornamental ponds.

To assess the activity of *Culex* mosquitoes in city and suburban catch basins, biology staff randomly inspected 40-50 basins on 4 occasions. The basins are a perfect habitat, providing *Culex* mosquitoes with standing water and decomposing leaf litter. *Culex restuans* larvae were found as early as June 1, which prompted the initial treatment using VectoLex CG. In order to determine efficacy and longevity of VectoLex CG, 13 basins were inspected weekly for 5 weeks beginning in early September. VectoLex provided excellent initial control with only egg rafts and first instar larvae found through 4 weeks-post treatment; pupae were found at the 5-week post mark.

Quality control continued to be an essential function for biology technicians. Habitats that were recently treated were re-checked to ensure control materials were properly applied and effective. Quality control efforts began with surveys of woodlots in April to assure proper treatment. Container, roadside ditch and catch basin surveys continued as the summer wore on.

New Jersey Light Traps

As in previous years, Bay County Mosquito Control completed regular mosquito trapping throughout the season. Trapping data was critical to the mosquito management program as it helped recognize mosquito numbers, species, and whether or not any of the mosquitoes were a disease threat. One of the main tools used in adult surveillance was the New Jersey Light Trap. Beginning in mid-May and continuing through mid-September, adult mosquitoes were collected in 15 traps placed throughout the county. The traps were placed in backyards where there was little or no competing light source. Samples were gathered three times each week, followed by counting and species identification. The total capture was 9,537 (Table 2), which was nearly 25% fewer than the 2008 season, which had represented an "average" year.

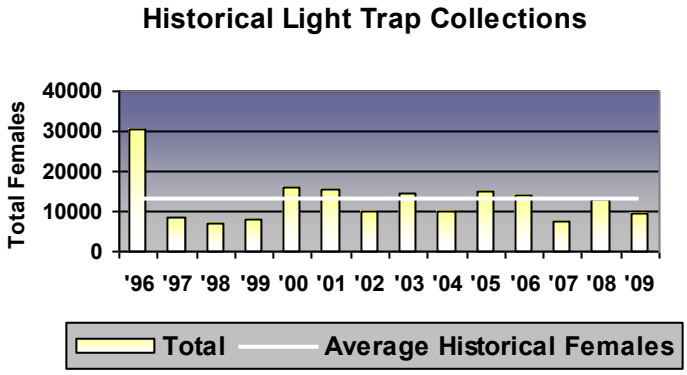
Table 2

Species	May	Jun	Jul	Aug	Sep	TOTAL
Ae. vexans	149	426	2368	1525	282	4750
Ae. intrudens	0	0	1	0	0	1
Ae. implicatus	10	16	0	0	0	26
Ae. stim/fitchii	39	125	152	18	8	342
Ae. canadensis	8	0	0	0	0	8
Ae. triseriatus	0	2	6	5	2	15
Ae. trivittatus	5	0	12	5	0	22
Ae. japonicus	0	1	4	2	3	10
An. punctipennis	4	17	29	51	7	108
An. quadrimaculatus	1	16	160	179	48	404
An. walkeri	11	517	935	654	37	2154
An. perplexens	0	6	0	0	1	7
Cs. Impatiens	3	0	2	0	1*	6
Cs. inornata	0	3	20	0	1	24
Cs. morsitans	1	0	1	0	0	2
Cq. perturbans	0	231	481	47	0	759
Cx. pipiens	0	23	32	159	47	261
Cx. restuans	19	94	176	202	38	529
Cx. tarsalis	1	0	0	0	0	1
Cx. territans	0	13	14	3	2	32
Ps.ciliata	0	1	0	0	0	1
Ps.ferox	0	0	1	1	0	2
Ur. sapphirina	0	0	2	0	2	4
Damaged	4	21	33	8	3	69
Male Mosquitoes	3560	1464	1517	2527	743	9811
Total Females	255	1512	4429	2859	482	9537

Twenty-four species were collected during the 2009 season and the most predominant was *Aedes vexans* (the floodwater mosquito), representing 50% of the total. It is not unusual for *Aedes vexans* to rank first because it's the floodwater mosquito and hatches after heavy rains flood ditches, fields, and woodlots. The *Anopheles* species (*quadrimaculatus*, *walkeri*, *punctipennis*, and *perplexens*) represented about 28% of the total catch. The northern house mosquito, *Culex pipiens* and other *Culex* species ranked third. Finally, we watched, with great interest, our newest mosquito species, *Aedes japonicus,* whose numbers remained virtually unchanged from 2007 and 2008 when eight and ten were captured, respectively.

Figure 1 offers a historical perspective of light trap collections with the average number collected in a given year represented by the solid white line. As you can see, the number collected in 2009 was below average. Typically, total number of females corresponds with the amount of rainfall received. In 2009, Bay County actually received well-above average precipitation in April and about an inch above average in June. These rains did lead to mosquito hatches; however, the below-average temperatures from April to September no doubt aided in the counts being lower than normal. Fewer mosquitoes were active and collected on cool evenings like those experienced this season. Average low temperatures during the seasonal trapping time frame were 50°F (May), 57°F (June), 59°F (July), 61°F (August), and 58°F (September). Low nightly temperatures actually fell below 60°F most evenings (70% of the time). Figure 2 (page 12) shows mosquito species collected per trap night throughout the summer. Summer floodwater *Aedes* and *Anopheles* peaked the week of July 19th and again on August 16. These peaks followed major rain events by 1-2 weeks.

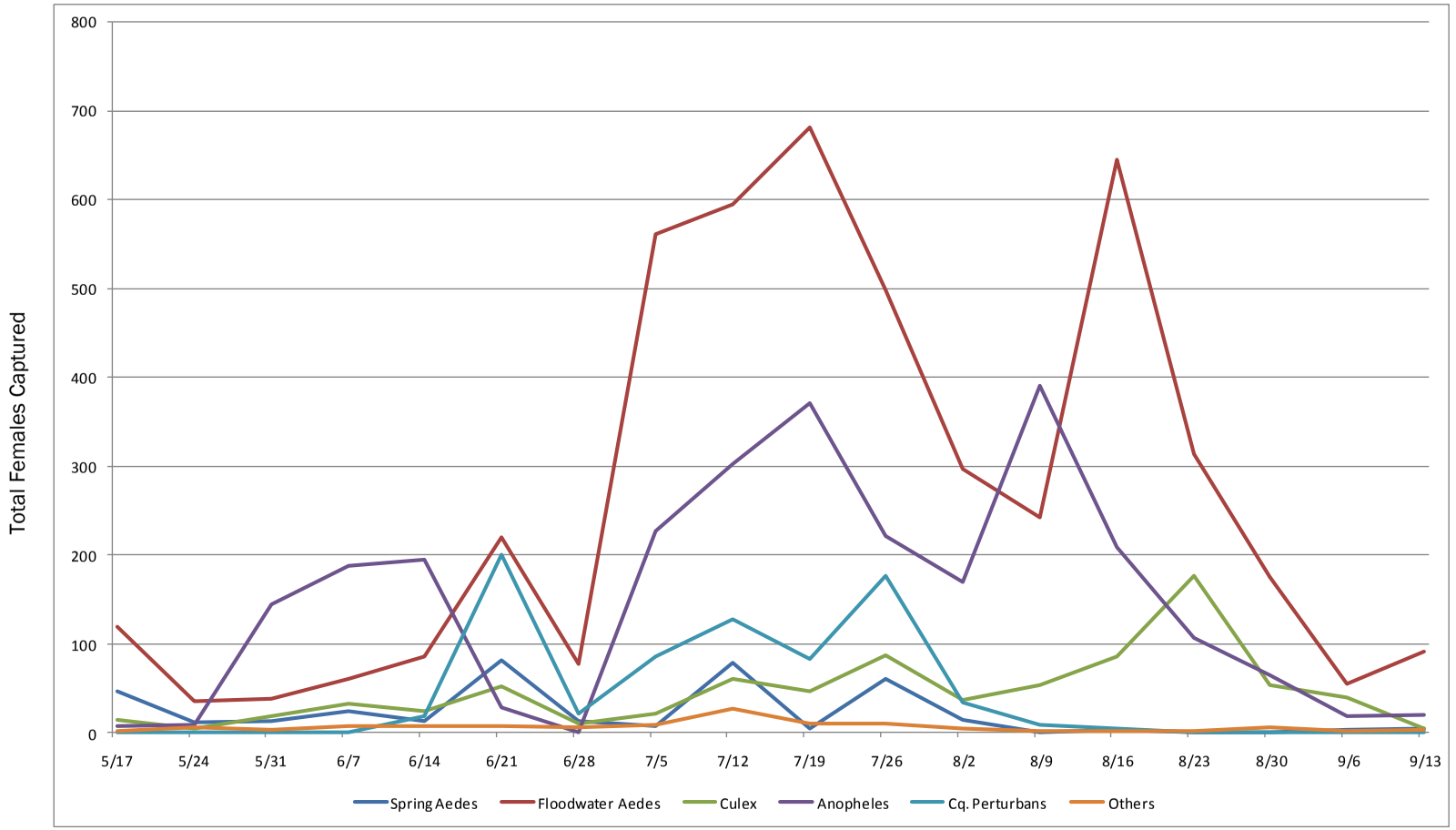
Figure 1



New Jersey Light Traps 2009

Weekly Captures

Figure 2



CDC Traps

CDC Traps attract blood-seeking female mosquitoes with the use of dry ice (carbon dioxide) as bait. Traps were placed overnight within woodlots, summer festival grounds, treatment sites, and personal residences. Usually the traps held diverse species and larger mosquito numbers compared to New Jersey Light Traps. Traps were also used to assess homeowner complaints, gather arbovirus information, and record changes in abundance of mosquitoes before and after control operations.

Total number of mosquitoes captured in CDC traps this year (29,176) was about 25% less than 2008 (Table 3). *Aedes vexans* remained at the top ranking spot, representing 42% of the total with *Coquillettidia perturbans* numbers up from 2008, comprising 16% of this year's total. Nineteen species in six genera were collected and identified and the average number of females per trap was 97 compared to 175 in 2008 and 118 in 2007.

Table 3

Species	May	Jun	Jul	Aug	Sep	TOTAL
Ae. vexans	232	1889	6249	2740	1076	12186
Ae. intrudens	1	58	8	0	0	67
Ae. implicatus	35	50	78	1	0	164
Ae. sticticus	16	1	0	7	0	24
Ae. stim/fitchii	831	1982	802	15	1	3631
Ae. canadensis	278	909	98	1	0	1286
Ae. triseriatus	0	4	18	28	8	58
Ae. trivittatus	53	215	1841	626	251	2986
Ae. japonicus	0	0	0	0	0	0
An. punctipennis	4	49	37	21	6	117
An. quadrimaculatus	0	301	187	56	9	553
An. walkeri	0	1257	332	342	23	1954
An. perplexens	1	1	0	0	0	2
Cs. inornata	2	0	4	1	1	8
Cq. perturbans	0	1539	2730	308	20	4597
Cx. pipiens	0	14	9	83	92	198
Cx. restuans	16	84	422	516	60	1098
Cx. territans	0	0	1	0	0	1
Ps. ferox	0	0	15	7	5	27
Damaged	20	79	92	19	9	219
Total Females	1489	8432	12923	4771	1561	29176

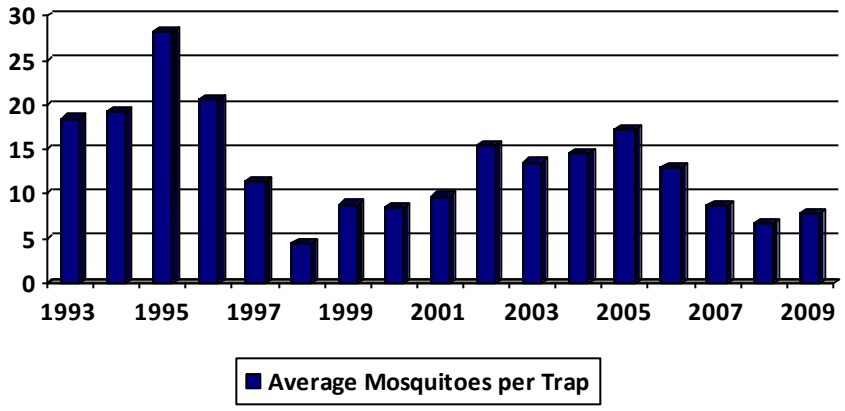
Gravid Traps

Gravid traps offered another method to collect female mosquitoes, primarily *Culex* species that had taken a blood meal and were searching for a suitable place to lay eggs (oviposit). This trap was selective for female mosquitoes that had at least one blood meal; therefore, the traps provided a good means for early West Nile Virus (WNV) detection.

A solution containing water, brewer's yeast, whey, and guinea pig pellets was allowed to ferment for about a week before being poured into a plastic tub, over top of which sat the gravid trap. This organically-rich water was the attractant to gravid (egg-bearing) females.

Gravid trap placement ran from June through September and 141 traps captured 1219 mosquitoes (1104 *Culex* species, 8 *Ae. japonicus*, 5 *Ae. vexans*, 2 *Anopheles* species, 3 *Ae. trivittatus*, 1 *Cq. perturbans*, 1 *Ae. triseriatus*, 10 damaged females and 85 males). Traps were placed in a variety of locations, including the immediate area of WNV activity. *Culex* mosquitoes collected in gravid traps were grouped together and submitted to MSU for WNV-detection or tested in-house with the VecTest kit. Figure 3 shows a historical perspective of the average number of mosquitoes collected per gravid trap.

Figure 3



Disease Surveillance

Since the inception of Bay County Mosquito Control, mosquito control efforts have been targeted at controlling nuisance mosquito species and known disease vectors. Our goal has always been to reduce mosquito numbers in order to decrease the risk of diseases transmitted by them. Since WNV came on the scene in 2001, our efforts at disease prevention and public education have taken on a bigger role.

Mosquito pools were submitted to MSU's Microbiology and Molecular Genetics Department to be analyzed. A mosquito pool is a group of up to 25 mosquitoes of the same species collected from a trap, placed in a vial, and tested for mosquito-borne disease. Some mosquito pools were also tested in-house using the VecTest kit. Four hundred two pools containing 7,680 females representing a variety of species were tested with the following results: *Cq. perturbans* (238 pools/4,923 females/no positives), *Culex* restuans (78 pools/1,198 females/2 West Nile Virus-positive pools), Culex pipiens (9 pools/144 females/no positives), Culex species (77 pools/1,415 females/no positives).

The 2 positive pools contained 50 females and were collected from one CDC trap on August 13th near McGraw and Broadway on Bay City's east side. No other mosquitoes collected from that area afterwards tested positive. A positive pool indicates local mosquitoes are infected with West Nile Virus and are capable of transmitting it to humans and other hosts.

We continued to rely on Bay County citizens reporting dead birds as one method of WNV surveillance. Using the WNV VecTest kit, American Crows and Blue Jays were tested to determine infection rates. The number of calls was down significantly this year from 100 in 2008 to 27 in 2009. Forty-three dead birds were reported, most of which were Purple Martins (9), Common Grackles/European Starlings/other blackbirds (9), Blue Jays (5) and American Crows (4). All dead bird sightings were logged onto Michigan's Emerging Diseases website www.michigan.gov/emergingdiseases. Five crows or jays were tested using the VecTest this summer with none testing positive. Compared to 2007 and 2008, disease activity remained at a low level for our county and statewide. There were no human cases reported this summer (Table 4), but there were 5 positive mosquito pools in the state—2 WNV-positives from Bay County, 2 from Saginaw County (1 WNV-positive *Culex* pool and 1 LaCrosse encephalitis *Aedes triseriatus* pool), and 1 WNV-positive *Culex* pool from Wayne County. Further, a Red-tailed Hawk tested positive for WNV in Lenawee County. Nationally, there were 602 human WNV cases (as of November 10th) with 26 deaths. Most of the U.S. cases (Figure 4) occurred in Texas (100 with 7 deaths), Colorado (99 cases with 3 deaths), and California (98 cases with 4 deaths).

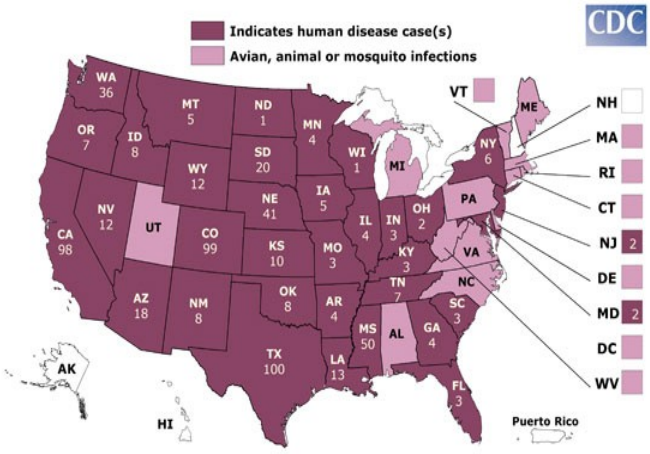
Table 4

Michigan Human WNV

State and National Data (as of 11-10-09)

Year	Total Cases	Fatalities
2009	0	0
2008	17	0
2007	13	2
2006	55	7
2005	62	4
2004	16	0
2003	19	2
2002	614	51

Figure 4



Product Evaluation—Natular

A new bacterial product known as Natular, whose active ingredient is Saccharopolyspora spinosa (a.k.a. spinosad), was evaluated in catch basins over a seventeen-week period during summer 2009. Except for a small four-block area left as a control, all other catch basins in the city of Essexville, which numbered 502, were treated with the Natular XRT (Extended Release Tablet) formulation.

Twenty catch basins were monitored—ten that received treatment and ten that were left as untreated controls. Pre-treatment surveys were taken followed by treatment on June 9, and then 24 hour, 48 hour, 72 hour, and weekly post-counts thereafter. Catch basin lids were lifted and 4-5 dips per catch basin were taken with water retrieved and deposited in an enamel pan. Close inspection of any mosquitoes in the pan was completed and results recorded. A total mosquito count was taken and then averaged. Depth and temperature were also recorded.

Throughout most of the summer, *Culex restuans* were the primary mosquito found in catch basins, but by September, most larvae were *Culex pipiens* species. Excellent control was achieved through nine weeks post-treatment. At the 10 week mark, a few treated catch basins showed larger stage mosquitoes and by the end of the study on September 23, four basins showed larger stages. The presence of third instar larvae or larger may indicate the product is no longer working. The last two observations (September 29 and October 6) showed little activity in any treated catch basin and reduced activity in controls. Mosquitoes were more than likely getting ready to enter diapause, a hibernation-like state that allows them to survive through winter. The Natular product showed definite promise as a long-term mosquito control material.

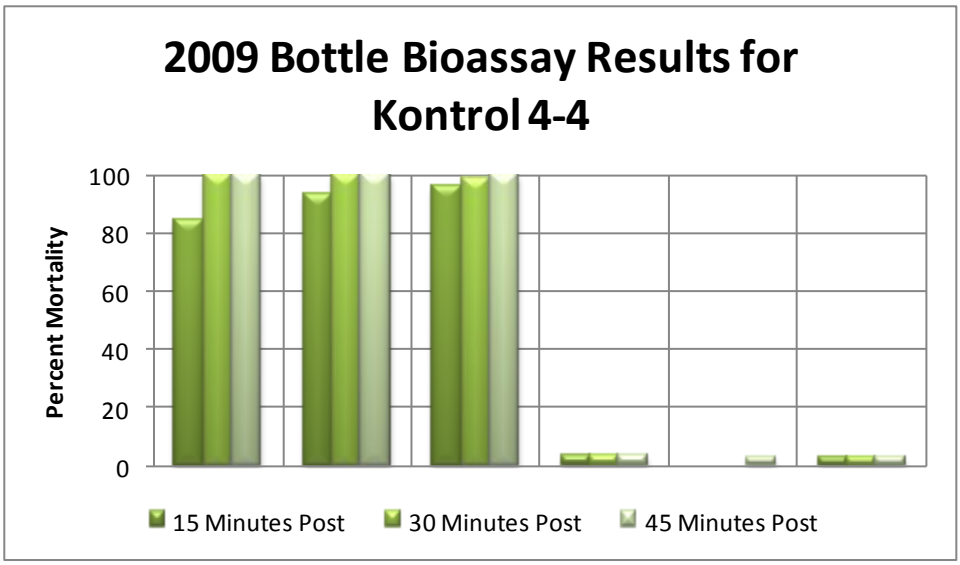
Natular XRG (a 30-day product) was applied to retention ponds with excellent initial control. However, dry conditions prevailed throughout the study and we were not able to determine the product's long-term residual potential. We will continue to evaluate the product in 2010.

Bottle Bioassay

Bottle bioassays are one method used to detect insecticide resistance, a threat to the success of any mosquito control program. A standard dose of insecticide is prepared and dispensed into four bottles then swirled around to thoroughly coat the inside of the bottle. This is followed by the introduction of wild adult mosquitoes. Mosquitoes are also placed in control bottles.

In 2009 three trials were run against several mosquito species, mostly *Aedes vexans* and *Aedes trivittatus*. Mortality was recorded every 15 minutes in both treated and control bottles. Results are shown below in Table 8 and were excellent. Near 100% mortality was achieved in all treated bottles by the 30-minute interval, while very little mortality was seen in the controls. The mosquito species tested continue to be susceptible to Kontrol 4-4 adulticide.

Table 8



VectoLex Surveillance in Catch Basins

Pre-treatment surveys were taken on September 2nd with 21 catch basins sampled. Of those 21 basins, 13 were chosen that had low or medium density larvae. After treatment on September 3rd-4th with VectoLex granules, post-treatment surveys were taken weekly through 5-weeks post-treatment. The VectoLex controlled mosquitoes through 4 weeks, as pupae were found at the 5-week mark. We will continue to look at VectoLex in 2010.

Weather

Mosquitoes, whose lifespan usually doesn't exceed more than three weeks, breed in stagnant bodies of water. Heavy rainfall can leave puddles and other bodies of water in which mosquitoes multiply. In April, Bay County received 6.78 inches of rain, double the typical 3.13 inches during the month, which marked the fourth wettest April on record. Furthermore, almost 4 inches fell during the last week of April. May and July saw rainfall totals that were below average while June and August rain was above average. September was one of the driest months in history with only 0.96 inches recorded. The most noteworthy event regarding September rainfall was that no rain was recorded for the first 20 days of the month and only 0.2 inches fell from September 21-23.

The 2009 season will be remembered as having below normal temperatures from April-September. During the first half of June, temperatures averaged around 5-6 degrees below normal, while July set a new record as the coldest July for the Saginaw Valley. Finally, August was closer to normal, but ended the last week with temperatures recorded in the 60s.

It is imperative to maintain weather data to predict both larval occurrence and when biting adults will emerge. Table 5 lists weather data occurring in Bay County during November-December of 2008 and January through October, 2009.

Table 5

Month	Normal Rainfall	2008/2009 Rainfall	Departure from Normal	Normal Average Maximum	2008/2009 Avg. Max. Temp.	Departure from Normal
November	2.65"	2.1"	- 0.55"	46.3°	43.8°	- 2.5°
December	2.18"	2.79"	+ 0.61"	34.2°	32.3°	- 1.9°
January	1.57"	0.96"	- 0.61"	29.2°	23.1°	- 6.1°
February	1.35"	2.57"	+ 1.22"	32.3°	34.6°	+2.3°
March	2.22"	2.71"	+ 0.49"	43.1°	46.2°	+ 3.1°
April	3.13"	6.78"	+ 3.65"	56.2°	54.7°	- 1.5°
May	2.74"	2.08"	- 0.66"	69°	66.5°	-2.5°
June	3.07"	3.79"	+ 0.72"	77.7°	73.4°	-4.3°
July	3.17"	2.36"	- 0.81"	82°	74.3°	-7.7°
August	3.43"	3.47"	+ 0.04"	79.5°	76.1°	-3.4°
September	3.76"	0.96"	- 2.8"	71.9°	70.6°	-1.3°
October	2.49"	4.19"	+1.70"	58.8°	55.4°	-3.4°

Spring Aerial Campaign

The 2009 mosquito control season began in April with aerial larviciding to control spring woodland mosquitoes. The operation targeted vulnerable larvae before they reached the adult, biting stage. The aerial program has gone on for over three decades in the Saginaw Valley and remains the best way to dramatically decrease numbers of spring *Aedes* mosquitoes. The preferred control method has been using a bacterial product known as *Bti* (*Bacillus thuringiensis israelensis*).

Earl's Spray Service, Inc. of Wheeler, Michigan used two aircraft to apply *Bti* to 29,380 woodland acres in the following townships: Beaver (6,592 acres), Fraser (4,245 acres), Garfield (5,320 acres), Gibson (1,245 acres), Kawkawlin (3,035 acres), Pinconning (5,943 acres), and Williams (3,000 acres). Calibration, loading, and fueling of the aircraft took place at Barstow Airport in Midland and sites were treated with VectoBac® *Bti* corncob granules at 4-5 pounds per acre.

Clarke Mosquito Control of Roselle, Illinois utilized one Jet Ranger helicopter to apply *Bti* to 6,984 acres the following townships: Bangor (2,608 acres), Frankenlust (772 acres), Hampton (616 acres), Mt. Forest (1,136 acres), Merritt (264 acres), Monitor (1,216 acres), and BCE/Portsmouth (372 acres).

Spring Ground Larviciding

The battle against Spring *Aedes* mosquitoes continued this year on a smaller scale, too. Table 6 lists the number of acres treated by foot crews and material used in smaller tracts of woodlots during the 2009 spring season.

Three certified technicians helped with aerial quality control, conducting post-treatment surveys to assess *Bti* application. These same technicians were the first to begin inspections and subsequent ground treatment using primarily *Bti* and Golden Bear larvicide oil to manage the spring mosquito larvae or pupae. We review our treatment maps annually to locate flooded woodlots that can be treated aerially rather than by foot. Aerial treatment provides a more efficient, time-saving treatment of flooded woodlots. Almost 450 acres received larval treatment by ground crews to control the emergence of the pestiferous spring *Aedes* mosquito.

Table 6 **Spring Ground Treatment**

Township	Acres Treated	GB-1111 (gal)	BVA2 (gal)	Bti (lb)
BCE	1			5
BCW	47.04	5.5		207.7
BANG	20.06	20.06		
ESSE	1.8			9
FRAN	7.88			39.42
GIBS	39.69		38.63	5.28
HAMP	79.29			396.47
MERR	0.05			0.25
MONI	71.45	41.87	29.51	0.36
MTFO	153.64	130.64	21.17	9.17
PORT	1.25			6.25
WILL	21.35	14.25	4	15.52
TOTAL	**444.5**	**212.32**	**93.31**	**694.42**

Summer Larviciding

Bay County residents enjoy spending time outdoors during summertime, but the presence of mosquitoes can interfere with outdoor recreation. We try hard, therefore, to reduce mosquito numbers so residents can enjoy Michigan's all-too-short summer.

Our comprehensive mosquito control program focused on routine surveillance and control of potential breeding sites to prevent adults from emerging. This program involved MDA-certified technicians applying insecticides to stagnant water throughout the county. During the breeding season, a team of 21 technicians inspected water habitats guided by a database of known breeding sites, citizen complaints, and high trap numbers. Homeowners were notified of property inspections either in person or through the use of a door hanger.

Efforts directed at larval control were accomplished by using bacterial, chemical, or sanitary (dumping water from containers) methods. Four bacterial products utilized to control larvae were VectoBac®G (*Bti*), *Bti* Briquets™, VectoLex® CG (*Bacillus sphaericus*) and Natular XRT (*Saccharopolyspora spinosa*); chemical insecticides included materials containing temephos (1% Skeeter Abate®, Provect 1G, ProVect 4E and Abate® 4-E), alcohol-based monomolecular surface films (Agnique® MMF and Agnique® MMFG) and petroleum-based oils (Golden Bear—1111 and BVA2). The Agnique MMFG was used near the Lake Huron bay front as well as sensitive wetland areas.

Larval Sites: The total number of breeding sites changes each year as new sites are added to the database and others are deleted. A total of 17,572 larval site inspections were conducted this season, but only 17% of those were actually treated with a larvicide material. These numbers are in keeping with previous years' data. Some of these sites were permanent breeding habitats while others were temporary and included ditches, containers, fields, woodlots, tires, idle pools, ornamental pools, and Saginaw Bay beachfront. Larvae were sampled by quickly skimming the water's surface with a dipper; some were collected and returned to the lab for identification. Technicians also controlled mosquitoes by dumping water from buckets, pails and other man-made containers (one method of source reduction) on a regular basis. This was the preferred method to eliminate mosquitoes from breeding in containers.

Events: In addition to surveillance and control in neighborhoods throughout the county, special attention was given to summertime outdoor recreational events, such as the Auburn Cornfest, Munger Potato Festival, Pig Gig Ribfest, and River of Time. According to the Bay Area Convention and Visitors Bureau, over a half million people attend these types of festivals. Controlling larvae prevents adults from emerging and interfering with outdoor recreation and activities.

Ditch Treatments: Bay County's topography is very flat and most roadways are flanked by ditches, which divert water from the county's 1,400 miles of roads. In addition, ditches serve as breeding grounds for mosquitoes, so a lot of attention is given to monitoring mosquito activity within them. In fact, surveys are made by lab personnel once each week. Most problems with breeding occur after major rainfall events, which stimulate mosquito eggs to hatch. Ditch trucks logged 8,176.6 miles driven, dispensing 4,623.8 gallons of Abate 4E mix (18 gal of Abate 4E), 109 gal of VectoBac 12AS mix (4.5 gal Bti), and 83 gal of BVA2.

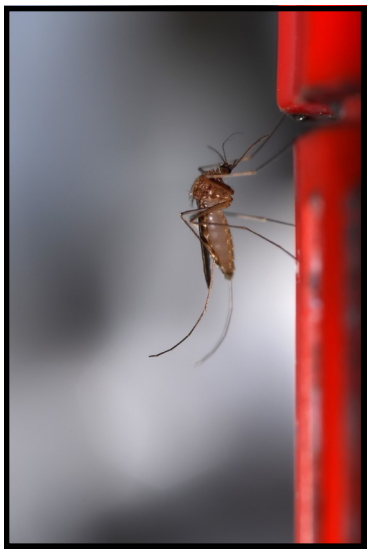
Catch Basins: BCMC staff monitored mosquito breeding in catch basins and used 1,235.9 lb of VectoLex® CG bacterial larvicide to treat 40,681 catch basins. In addition, 5.76 gal of Abate 4E mix was dispensed into Bay City East catch basins and 502 Natular XR Tablets were used to treat Essexville catch basins.

Sewage Lagoons: Sewage lagoons are perfect breeding zones for *Culex* mosquitoes as they're filled with polluted, highly organic water all summer long. Eleven sewage lagoons were monitored this season resulting in 36 treatments using the following products: 19 gal of Abate 4E mix (9.5 oz. Abate 4E), 3.28 gal of liquid Bti mix (VectoBac 12AS) or 17.4 oz. of liquid Bti, 29 *Bti* Briquets, and 50.2 gal of BVA2.

Retention Ponds: These ponds were designed to hold storm water until the water either percolated or evaporated, which returned the area to its normal dry state. Floodwater mosquitoes were usually the first to appear in retention ponds, but *Culex* and *Anopheles* mosquitoes could also be found. BCMC surveyed 106 retention ponds throughout the county, treating them with a variety of products: Abate 1% (7.4 lb), *Bti* Briquets (44.5), *Bti* (50.22 lb), BVA2 (8.4 gal), and Provect 1G (1 lb). As in other larviciding endeavors, treatment did not occur after each survey. In fact, 373 larval surveys of retention ponds were made with nearly 90% of these resulting in no treatment.

Retention Pond books were used during the 2009 season for the first time. The books contained detailed information about the location and size of each retention pond and were organized by township. Each retention pond was shown on an aerial map to give technicians a way to quickly locate them. The idea behind the retention pond books was to make surveillance and treatment more efficient and timely.

Adulticiding



While larval control was the preferred method of treatment, it was virtually impossible to find and treat all breeding sites, so adulticiding (fogging to kill adult mosquitoes in flight) was also carried out to control mosquitoes. Adult mosquito activity increased following periods of heavy rains, which caused new mosquito broods to hatch. Fogging adult mosquitoes included the use of ULV (Ultra Low Volume) equipment that allowed a relatively small amount of material to be dispensed. Application rates were adhered to by using GPS units with SmartFlow technology in each truck. Label recommendations were followed strictly to assure proper dosage rates and droplet sizes during adulticide applications. To accomplish the latter, droplet measurements were taken several times throughout the season. The first droplet characterization session took place in early May with Clarke Mosquito Control's Jake Britton using the AIMS (Army Insecticide Measuring System) to measure aerosol droplets (see picture at right); software was utilized to store electronic files. Subsequent checks of droplet sizes took place using the Teflon slide method.

When weather conditions were conducive to fogging (temperatures above 50°F and winds below 10 mph), eight certified technicians fogged cities and townships that had either the highest mosquito counts or noted disease activity. This year saw the routine use of the permethrin product Kontrol® 4-4. Mosquitoes must come in contact with the droplets in order for the insecticide to be effective so adulticiding activities took place after sunset when most mosquito species were active and bees had returned to their hives.

For management purposes, Bay County initiated the use of route maps during adulticiding operations. These road maps of each township showed the most efficient route to follow when adulticiding. The maps also highlighted addresses of medical and no spray residences. Medical residences are homes that qualify to be a part of our Medical Needs Program because at least one resident is allergic to mosquito bites or has verifiable medical needs. The medical condition must be confirmed by a medical doctor. No spray residences are homes that prefer not to be treated for mosquitoes.

Adulticiding Treatment

Table 7

Township	Miles Treated	Kontrol 4-4 (gal)
BANG	2659.7	490.9
BCE	664.0	145.6
BCW	458.8	88.2
BEAV	1049.4	173.3
ESSE	129.2	23.6
FRAN	877.2	128.7
FRAS	1048.6	176.4
GARF	1162.7	189
GIBS	1147.2	198
HAMP	1774.9	300.4
KAWK	2164.2	384.7
MERR	700.9	118.9
MONI	2999.0	569.3
MTFO	1172.7	215.4
PINC	1429.9	231.1
PORT	942.0	172.7
WILL	2073.4	307
TOTAL	**22453.8**	**3913.2**

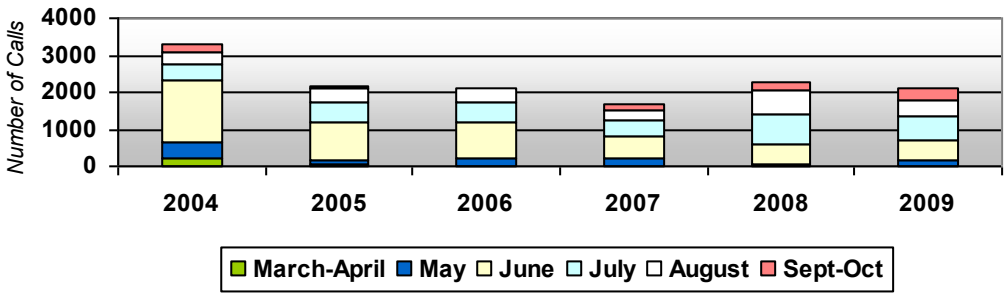
During the 2009 season, the "Long Driveway Program" continued. This program was designed to fog inhabited properties that sat a considerable distance off the main road and that did not receive adequate adult mosquito control during normal fogging operations. Thirty-eight such addresses were placed on route maps to be fogged on a regular basis. During the 2009 season, 22,453.8 miles were logged during adulticiding operations (Table 7) and nearly 4,000 gallons of Kontrol 4-4 were dispensed.

Customer Calls

Traps were the primary indicator of mosquito activity, but customer calls were also used as a means to indicate where adult populations were problematic. Office staff answered and technicians responded to 2,092 adult mosquito service requests received from Bay County citizens. Most (1,391) of the calls were regular service requests for adulticide treatment due to nuisance mosquitoes, but an additional 701 calls represented special event spray requests. Seventeen percent of the callers also reported standing water with potential mosquito breeding; this amounted to 349 larval mosquito requests. In comparison to 2008, the level of customer service requests decreased by 9%. Most of the calls were received in July (619), followed by June with 577; calls peaked about two weeks after major rain events. Regardless of the type of service request, all were responded to in a professional, courteous, and prompt fashion. Figure 5 represents a historical profile of adulticide requests; the number of calls positively correlates with rainfall.

Figure 5

Service Request Profile
Adulticiding Requests



Scrap Tire Drives

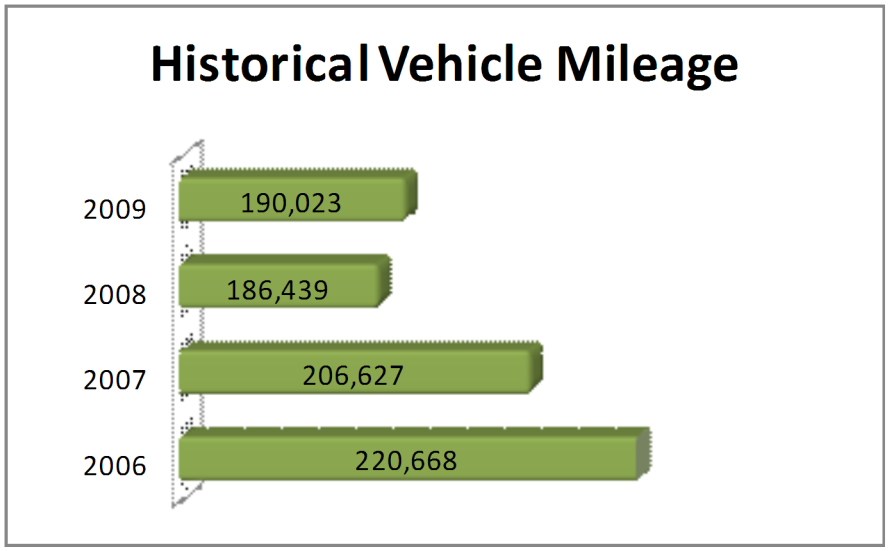
Scrap tire drives were one method of source reduction, the removal or elimination of breeding sources that currently are or have the potential to breed mosquitoes. Two community tire drives were held this summer (June 19-20 and October 2-3) with 5,084 tires collected—21% more than was collected in 2007.

Vehicle Maintenance

Bay County Mosquito Control's state-certified mechanic maintained the 32-vehicle fleet as well as four Bay County Animal Control vehicles, which were billed for parts and labor. During the 2009 season, as Figure 6 shows, 190,023 miles were driven, which is near the average of 193,381 miles.

One new vehicle was purchased this season—a 2009 Chevrolet Silverado 4 x 4 truck. Vehicle maintenance repairs included the following: brake systems (20), fuel systems (5), front end repairs (10), truck oil changes (75), electrical systems (20), drive lines (10), new tires (36), and used tire repair (15). In addition to maintaining the vehicles, the mechanic was responsible for repairing and maintaining equipment used by mosquito control staff. Equipment repairs included 52 ULV oil changes, ULV repairs (50), ditch truck repairs (11), Hudson® pressure sprayer repairs (9), spreader repairs (10), CDC Trap repairs (5), and New Jersey Light Trap repairs (6).

Figure 6



Education

Extensive efforts were made to inform and educate Bay County residents about mosquito control methods and mosquito-borne diseases. A great deal of education took place every day through hundreds of personal contacts in the field and calls to the office. Periodic interviews by newspaper, television, and radio allowed discussion of news affecting the public, such as spring aerial treatment, summer programs, homeowner property inspections for water elimination, West Nile encephalitis, and scrap tire drives. Staff training was also held on a regular basis to update staff on various topics including safety, disease activity, and policies and procedures.

Presentations were also given to various groups, including school-based programs, and the Website (www.baycounty-mi.gov/MosquitoControl) was updated on a regular basis. Public relations brochures and handouts were developed and distributed.

Membership/Certification

Membership in professional organizations remained vital in accessing updated and new information and maintaining good working relationships with peers. Membership with the non-profit Michigan Mosquito Control Association (MMCA), American Mosquito Control Association (AMCA), and The Entomological Society of America were maintained. All were beneficial due to conferences, publications, networking, and legislative advocacy.

All staff members maintained certification with the Michigan Department of Agriculture in both the Core category and 7F (Mosquito Control). Two training sessions were held May 8 and June 8 with thirty-one new and returning technicians in attendance. Staff also attended the MMCA annual meeting in Ann Arbor, Michigan on February 4-5 and the MMCA 2009 Mosquito Control Training Session on December 2 in Bay City, both of which offered continuing education credits.

BCMC's program plan was reviewed and approved in January by the Department of Agriculture as part of our Comprehensive Community Outreach as mandated in Regulation 637.

Staff attended the Technical Advisory Committee (TAC) annual meeting on March 4, 2009 where the 2008 annual report and 2009 program plan were presented for review and approval.

2009 Insecticide Use Summary			
Trade Name	**Application Rate**	**Active Ingredient Dosage**	**Amount Used**
1% Skeeter Abate®	10 lbs/acre	0.1 lb temephos/acre	280.7 lb
Provect 1G	10 lbs/acre	0.1 lb temephos/acre	542.26 lb
Abate® 4E	1.5 fl oz/acre	0.0468 lb temephos/acre	19.62 gal
Abate WSP Basin Bags	1 pouch/100 sq ft	0.02 lb temephos/catch basin	203 ea
Summit Bti Briquets™	1/100 square feet	7000 AA (Aedes aegypti) Bti ITU/mg	1380 briquets
VectoLex® CG	5-10 lbs/acre	1.52 billion Bs ITU/acre	1327.84 lb
VectoBac® G	5 lbs/acre	0.4555 billion Bti ITU/acre	180,588.9 lb
VectoBac Liquid	1 pint/acre	0.605 billion ITU/acre	4.54 gal
Agnique® MMF	0.2—1.0 gal/acre	0.2—1.0 gal alcohol-based surface film/acre	4.3 gal
Agnique MMF-G	7-21.5 lbs/acre	2.24—6.88 lb alcohol-based surface film/acre	13.06 lb
BVA2 Mosquito Larvicide Oil	1—5 gal/acre	0.987-2.96 gal petroleum distillates/acre	510 gal
Mosquito Larvicide GB-1111	1—5 gal/acre	0.987-2.96 gal petroleum distillates/acre	363 gal
Masterline Kontrol 4-4	0.676 fl oz/acre	0.00176 lb permethrin/acre 0.00176 lb PBO/acre	3600 gal
Natular XRT	1 XRT tablet/catch basin	6.25% spinosad/tablet	42.78 lb
Natular XRG	5 lbs/acre	0.125 lb spinosad/acre	45.4 lb

Map of Bay County, Michigan